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Exploiting Advanced Technology to Producing Clean Energy in Sustainable Interior Space: Jordan as a Case Study

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Abstract:
The aim of this study is to exploit some advanced technological equipment that could be used in the Interior spaces as new sources of producing clean energy, and to give some insight on how it can enhance some dynamic functions. It can also provide some aesthetic inspiration in present and future interior designs and use of new sustainable technology with deeply taking into the account producing the clean energy as a source of this development. The theoretical part goes through a brief definition of the new sustainability technologies, home automation system, human - building relationship, reactive & proactive building responses, presence detectors, motion detectors as a reactive building responses, KNX control system as a proactive building responses.
Then the researcher will go through the use of these advanced technologies like a home automation system in Jordan by using descriptive analytical approach, in two case studies (villa. & company in Amman, Jordan). I collect the information of this villa from the engineers works in this company and its owners , then draw many of the important results like "a set of indicators, which includes the application of the ideal usage of sustainable technology as a source to produce the clean energy in the Jordanian interior designs and to provide a healthy environment in the interior spaces and many of tables shone the reduced energy consumption (%) through the sustainable technology in these two case study". then draw conclusions like " Home automation one of the most important sustainable technology, include centralized control of lighting, HVAC (heating, ventilation and air conditioning), appliances, security locks of gates and doors and other systems, to provide improved convenience, comfort, energy efficiency and security" and list of references.
Keywords: ADVANCED TECHNOLOGIES, CLEAN ENERGY , JORDAN INTERIOR SPACE

1. Introduction

Energy is a key aspect of sustainable development. The present energy system is mainly based on fossil fuels. This trend is unsustainable for a number of reasons: threats of man-made climate change by greenhouse gas emissions, the rapid depletion of fossil fuels, rising energy prices due to increasing demand, geopolitical uncertainty, and threat of instability in oil-rich countries. Solutions will be found in massive energy efficiency.(Vergragt, P. J. 2006)
Houses are completely prefab and recyclable, with high isolation and natural ventilation, solar systems, heat and cold storage, solar lighting aided by heliostats, and highly isolating windows and shutters (Vergragt, and H.S. Brown 2006).

1.2 The Sustainability of New Technologies

. In order to evaluate our energy dependence, we need to consider the sustainability of new technologies before introducing them to our society. New technologies continue to emerge with one major factor in common—dependence on electricity. When we, as technical communicators, evaluate, consider and implement these new technologies, should we also be considering their sustainability? The issue at hand is our vulnerability. (Vergragt, P. J. 2005). If we exhaust all natural resources, what will our society use as an energy source to power our computers and light our homes? We need to evaluate our extreme dependence on electricity so that we are prepared for the possibility of a future without traditional sources of electricity. In order to evaluate our energy dependence, do we need to consider the sustainability of new technologies before introducing them to our society. (Vergragt, 2003)

1.3 The Problems Associated with Electricity

Most of us rarely consider the electricity we use every day. Electricity has become one of the most important aspects of the technological world as each new technology becomes increasingly reliant on it as a source of power. (Marvin,1988).
Every time we turn on our computers, flip a light switch or watch a movie, we not only employ the technology but the energy source that comes with it. We take electricity, and its accessibility, for granted because it is prevalent in every home, office and building in Amman . Does this pose a problem for the technological future of Jordan? As technical communicators, we need to evaluate what would happen to our society if we could no longer rely on traditional sources of energy. (Morse, 2001)

2. Home Automation system

During the 1990s home automation rose to prominence. (Gerhart,1999) By the end of the decade, demotic's was commonly used to describe any system in which informatics and telemetric were combined to support activities in the home. (Anogianakis, 1997). The phrase appears to be a portmanteau word formed from domus (Latin, meaning house) and informatics, and therefore refers specifically to the application of computer and robot technologies to domestic appliances.

Despite interest in home automation, by the end of the 1990s there was not a widespread uptake - with such systems still considered the domain of hobbyists or the rich. The lack of a single, simplified, protocol and high cost of entry has put off consumers. While there is still much room for growth, according to ABI Research, 1.5 million home automation systems were installed in the US in 2012, and a sharp uptake could see shipments topping over 8 million in 2017. (Jonathan, 2012).

consumer electronic device control, energy management and efficiency home and commercial building automation as well as industrial plant management. The Smart home energy network has gained widespread attentions due to its flexible integration into everyday life. (Griffiths, 2012). This next generation green home system transparently unifies various home appliances, smart sensors and wireless communication technologies. The green home energy network gradually forms a complex system to process various tasks.

Designing for interaction take accounts two main levels, Human-to-Human relationship & Human-to-Nature relationship.

2.1 Human-to-Human relationship

It occurs within the building, it actually includes interaction between humans and the building, (e.g :walking into it, to decorating to using it as whole , etc…) leads to:

2.2 Human-to-Nature relationship

Interaction between the artifact (the building) and its non-human surroundings (e.g. the building is reacting to weather or environment, etc…

2.3 Human - Building relationship is interested into 2 main categories

2.3.1.Reactive building responses

(e.g. the opening of doors or windows in a building, materials used that react to human action…)

2.3.2 Proactive building actions:

based on a advanced technological relationship between building and its inhabitants (the building itself makes decisions on how to interact based on technology incorporated into the building design), e.g. shutters adjust automatically to outside heat.

3. Methodology and Procedures:

This study uses the descriptive analytical approach and limited two case studies (villa. Mohammed Al Kalelei in al Jubaiha & Noor AlA Noor Accusation company in khaldah, Amman, Jordan). from 2011 to 2012.

The data regarding the villa and the company was collected throw interviews with the supervisors and workers and employs, colored photos and site visits.

A table consisted of Automation system approach was demonstrated among interior design experts.

Electric invoices for two cases over one year were registered, analyzed and compared to previous ones in order to realize the saving of energy in the said period.

4. The Application of Reactive building responses in Jordan.

In this paragraph we will discuss the use sustainable technology as a source of producing clean energy in the Jordanian interior design. By using Descriptive analytical approach, we chose 2 case studies in Amman, villa and company.

4.1 The Usage Of Presence Sensor

the infrared presence detector recognizes presence in offices or workrooms and automatically provides lighting

pleasant working environment.

Even Small movements by persons sitting at computer terminals are recognized. (Theben, web1, 2013)

Energy is automatically saved when the room is

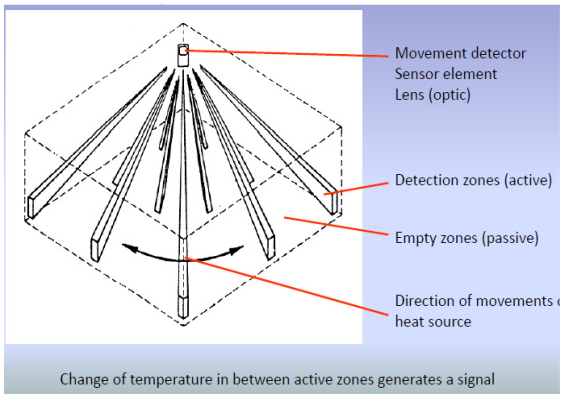

Fig. 1: Principle of a "PIR [passive infrared radiation movement detector [7].

unoccupied as the lighting is switched off and heating, ventilation and air conditioning are reduced to a minimum. see Figure: 1

- Switching and dimming
- 2 switching outputs (HVAC)
- Passive infrared sensors
- Remote operation

4.1.1 Advantages of Presence - vs. Movement Detectors

1. 360° square detection area
2. Self learning time delay
3. Automatically detection sensitivity
4. Distinction between day- & artificial light
5. Push-button control
6. Master – Slave – Principe
7. Selective semi- or fully automatically
8. 2 switched outputs light
9. Switched outputs light and HVAC
10. BUS-communication
11. Start-up tool
12. Inrush Current Limitation . (Griffiths, 2012).

we can see in the Figure.2, (Theben, 2013) the model of presence comparison by areas of application.

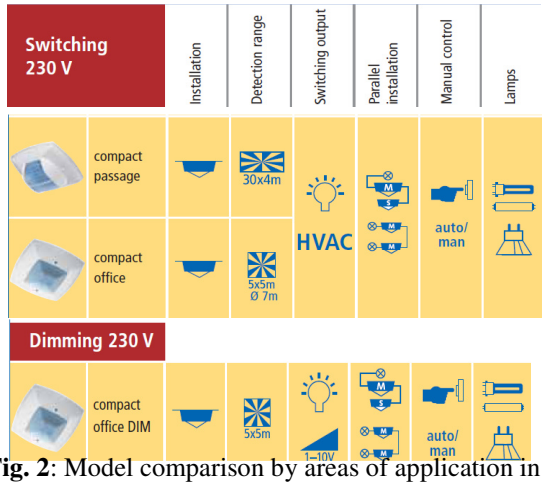

Fig. 2: Model comparison by areas of application in presence detector (Theben, web1, 2013)

4.1.2 Noor AlA Noor association company use individual offices in Amman / Jordan.

It's association company Established in 1991, & In 2008 it's started to control lighting ,HVAC and presence. in it's building, designed by Eng.hothyfa addebs, executed by Eng.mohannd khalifa & Eng.Osama Abdallah. uses flexible working hours requires a high state of readiness in the building technology. The idea of switching the lighting off in all the buildings at 8 pm with a "centralized OFF" command does not meet requirements as is clearly shown by the facade being illuminated all night long. During the current renovation work a centralized control system was rejected for reasons of cost and a decentralized light control system with theben HTS presence sensors was chosen instead. The user can manually switch the lights on or off in individual offices or meeting rooms at any time. The compact office presence sensor has an input for conventional sensors or switches for this purpose. The benefits are obvious; manual override offers optimal working conditions with the maximum possible energy savings. Compact office is very flexible. While a single presence sensor provides automatic light control in small offices, two sensors are used in larger offices and meeting rooms. Both sensors control two sets of lights with two different light switching values and joint presence detection using a master-master parallel circuit. QuickSet plus allows the presence sensors to be installed quickly and efficiently. The electrician estimates saving around two hours for installing the first 40 presence sensors. And the client benefits - despite the building being rented - from considerable savings in running costs.

4.2 KNX / EIB Control buildings – control cities

• Time controlling : Timers
• Light controlling : Twilight switches , Presence ,Motion , Staircase time switches
• Systems for living comfort
• Climate controls Clock thermostat ,
• BUS Technologies System KNX: CO2 , Hygrostaty
• Industrial solutions / OEM

Their aim is to provide a Bus system with fully compatible devices providing a high degree of interworking with and one software.

4.2.1 EIB (European installation Bus):

A Bus system introduce by konnex association to control applications in residential and non-residential buildings.

4.2.2 KNX Association

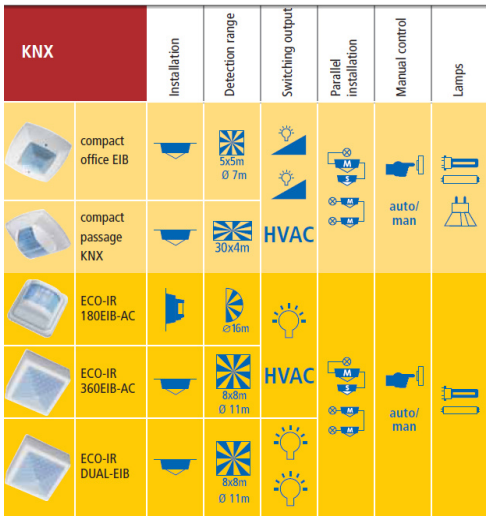

Fig. 3:. Model comparison by areas of application in KNX system (Theben, web1, 2013)

5. The Application of Proactive building responses in Jordan.

5.1 The Usage Of KNX Building control system.

Heating, Ventilation, lighting, blinds, The Theben KNX building

controller controls everything that belongs in buildings with modern comfort levels and all in an energy efficient manner and with all components perfectly matched to each other.
It has been set up in 1999 with headquarters in Brussels as a merger between three former European associations promoting intelligent home and building (BCI- France, EIBA- Belgium, EHSA- Holland).

5.2 Main Application of KNX system.

- Lighting/ Dimming Control.
- Curtains/ Shutters Control .
- Security Control.
- Visualization and display
- Audio/ Video Control.
- Temp. Control.
- hotel Door Access.

See Figure: 3 show the Model comparison by areas of application. (Theben, 2013)

5.3 Astronomical time switch / Solar time switch

5.3.1 what is the solar time switch?

- An solar time switch, like SELEKTA 170 top2
- calculates the sunrise and sunset times for each day of the year
- Sunrise and sunset times
- vary from location to location around the world
- depend upon the time zone
    - Switching times are therefore calculated from:
    - longitude
    - latitude
    - date and time zone

5.3.2 What are the benefits of an solar time switch?

- Precisely calculated switching times
- Accurate knowledge of daylight hours
- No external sensor required
  (less cabling work, no dirty sensor, no vandalism)
- No constraints concerning place of installation
- Possible to shift switching point (Offset)
- Depending on type solar and time switch function
  (without sun set/ sun rise influence possible)
- hat are the applications for a solar time switch?
- Street lighting
- Display window lighting
- Corporate logo lighting
- Courtyard entrance lighting
- Car parking
- etc. (Theben, 2013)

5.4 Example of usage KNX system:

5.4.1 Noor AlA Noor khalda branch Company.

Light control in open-space offices with the compact office DIM presence sensor, Noor AlA Noor khalda branch with 90 employs, uses Theben HTS presence sensors with constant light control in its new building. A total of 50 presence sensors were installed. The integration of various services and departments in one building poses the planners and users with several challenges. A dual cell structure was chosen for all the building services. Two workplaces always form one work station which lighting is set up for. The aim was to create flexible lighting, regulated by daylight, that is adjusted to working time and that controls lighting on a sector basis. Two test installations proved our presence sensors to be very easy to assemble, simple to use and efficient, thereby outdoing the alternatives Luxmate or KNX .The compact office DIM presence sensor is an integrated light control that combines presence detection with constant light control in one device. The square coverage area of the sensor makes planning easy. The areas covered by several sensors are perfectly aligned providing reliable coverage. All settings can be programmed by the press of a button with the QuickSet plus service remote control which saves a huge amount of time during the configuration process. The client expressed his satisfaction with the completed project which offers the highest levels of comfort with maximum energy savings and the users are clearly happy with.

5.4.2 Mohammad Alkhalil villa.

It was build in 2010 and the KNX control system was installed in 2011, designed by Eng.hothyfa addebs and executed by Eng.mohannd khalifa , upgraded by Eng.Osama Abdallah. This client needed the maximum level of luxurious and the best methods to save energy.

They used the customized and energy -efficient lighting control from theben. There are lots of options for customised and energy-efficient lighting.

PIR motion detectors outside provide greater security. see Figure: 4 the sensor control outdoor lighting according to the natural lighting. PIR presence detectors enable presence dependent and energy saving for lighting and heating.

theben twilight switches allow brightness dependent control of lighting and thereby reduce CO_2 emissions. Staircase time switches such as ELPA 8 reliably provide secure lighting on stairs and the lighting scenes of the theben dimmers help to create a pleasant atmosphere at indoor home.

Fig. 4: [Brightness/Lighting] sensor to control outdoor lighting according to the natural lighting [M.K villa[researcher photo]

5.4.2.1 Indoor and outdoor motion detectors

They also used Indoor and outdoor motion detectors from theben Light means security. theben PIR, motion detectors reliably switch on lights in hallways, staircases or in the garden as soon as movement is picked up in its detection area. That means the light only comes on when you need it to. Theben has the right motion detector for every application: Choose between wall or ceiling-mounted, between flush mounted or surface mounted and detection area range of 110° to 360.

5.4.2.2 Keypads , Touch screens & detectors

- Remote control [IR , over Internet].
- Proximity reading. see Figure. 5

5.4.2. 3HVAC control Description

Glass front in black

■Multi-functional display with room thermostat

■Glass front in white or black

■Freely configurable for displaying and controlling functions e.g. light settings, sun protection systems

■Illuminated display and integrated timer

■For control and regulation of heating, fan coils, air conditioning systems

■Up to 7 different display pages

■■Automatic summer/winter time adjustment with power reserve

■Controls up to 8 rooms via own temperature profiles

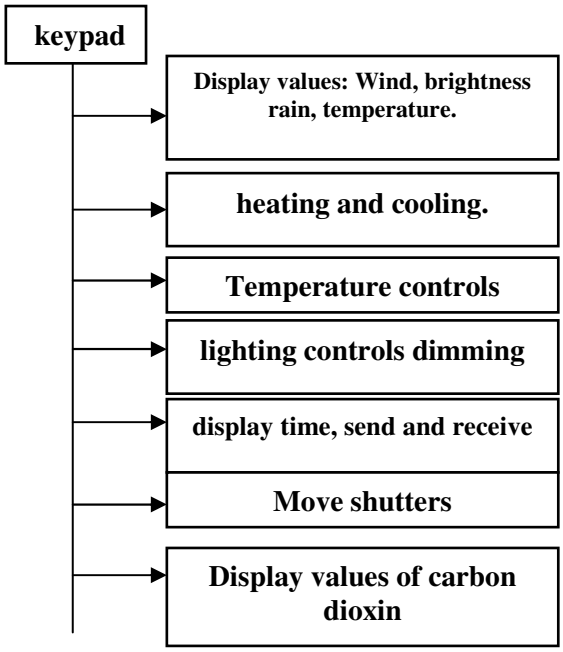

Fig. 5: keypad control systems. in M.K villa

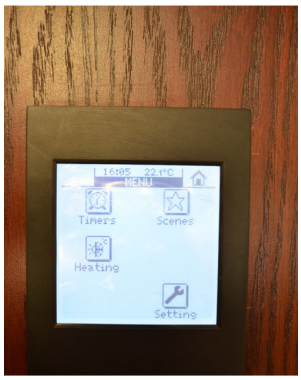

Fig. 8: Heating, timer and scones keypad. in Ground floor M.K villa

■Weekly time switch with 8 channels

Fig. 7: Under Floor heating (UFH) Cabinet [theben values] M.K villa

Fig. 6: HACP / Home Automation control panel in Ground floor M.K villa

Fig. 9: Motion detector Ground Floor.(passage). in M.K villa

with up to 3
different statuses, e.g. for light, shutters, fans etc.
■3 heating programs
■Alternative continuous or on/off control
■Operation modes: comfort, stand-by, temperature reduction at night, frost protection
■Weather data from theben weather stations can be displayed.
HACP / Home Automation control panel is located in Ground floor see Figure. 6, also they used the Under Floor heating (UFH) Cabinet
(theben, 2013) to save more energy see Figure. 7.
The curtains/ Shutters Control and Security Control and intercom integrated with HA. in Ground floor..
These application in Addition to the timer scenario / Video, temp. control & Motion detector(passage). we can find it in the keypad located in the ground floor See Figure. 8, Figure,9.

Table: 1 show the(presence detector as green Energy saving factor)in Noor AlA Noor Company.

Product / function	**Percentage %**
HTS Presence detection control - Lighting	25-45%
Day light harvesting - Lighting	35-50%
Time scheduling -Lighting	15-25%
Occupancy/non-occupancy - Air conditioning	35-50%
Presence detection - Heating	5-10%

6. The Results

After discussing the two case studies and analysing the usage of (Home Automation Control system) as a sustainable technology to produce a clean energy, this research found a set of indicators, which include the application of the ideal usage of sustainable technology as a source to produce the clean energy in the Jordanian interior designs and to provide a healthy environment in the interior spaces. The tables below show the reduced energy consumption (%) through the sustainable technology in Noor ala Noor Co. and Mohammad Al Khalili villa.

See tables 1, 2, 3,4,5 and 6
In Tables1, & 2 we can show the presence detector product function in NOOR-ala-NOOR Company branch in Khalda and Mohammad Alkhalil villa in Jubaiha:
The day light harvesting and lighting is higher percentage from the other factors but presence detection heating is lower than all factors.

- In table 3. we can show the reduced energy consumption (%) percentage of the KNX uses, in Mohammad Alkhalil villa:

the Lighting Automation is higher percentage from the other factors while heating automation is lower than all factors.

- In table 4. we can show the reduced energy consumption (%) percentage of the Blind control uses, in Mohammad Alkhalil villa:

Brightness and presence saving (HVAC)is higher percentage from the other factors but Brightness depending saving (HVAC), and Lighting in the same percentage**.**

Table. 2 show the(presence detector as green Energy saving factor) in Mohammad Alkhalil villa

Product / function	Percentage%
HTS Presence detection control - Lighting	15-35%
Day light harvesting - Lighting	20-30%
Time scheduling - Lighting	10-20%
Occupancy/non-occupancy - Air conditioning	17-30%
Presence detection - Heating	49%

- In table 6. we can show the reduced energy consumption (%) percentage of the Lighting control uses, in Mohammad Alkhalil villa:

Constant brightness control is higher percentage from the other factors but the blind control is the lower than all factors .

Table. 3 show the reduced energy consumption (%) through the use of KNX in Mohammad Alkhalil villa

Product / function	Percentage%
individual room regulation 50%.	50%
Heating Automation 40%.	40%
Blind Window Automation 45%.	45%
Lighting Automation 80%.	80%
Ventilation Automation	60%

Table. 4 show the reduced energy consumption (%) through the use of Blind control in Mohammad Alkhalil villa

Blind Control	Percentage%
Brightness depending saving (HVAC)	13
Brightness and presence saving (lighting)	13
Brightness and presence saving (HVAC)	21

7. Conclusions:

- society of the future, one which is sustainable, attractive, and fulfills human needs and aspirations.
- the Evaluation of New Technologies According to Their Sustainability Prevent us to continue to accept every new technology proposed to our society without considering the long-term effects of it.

Table .5 show the reduced energy consumption (%) through the use of HVAC control in Mohammad Alkhalil villa

HVAC Control	Percentage%
Time controlled per room	10%
Presence depending	25%

-
- Many new technologies seem wonderful at first, but sometimes innovators worry more about advancing the technological world than conserving the environmental world.
- If we are selective when integrating new technologies, we are able to forgo blackouts and power outages, we can save natural resources and the environment, and we can save ourselves from becoming too reliant on energy from other nations and irreplaceable resources.
- Electricity comes from a variety of sources some renewable, others irreplaceable, When we fail to consider the amount of electricity being consumed by our televisions and computer monitors, we fail to consider the environment.
- Home automation one of the most important sustainable technology, include centralized control of lighting, HVAC (heating, ventilation and air conditioning), appliances, security locks of gates and doors and other systems, to provide improved convenience, comfort, energy efficiency and security.

Table .6 show the reduced energy consumption (%) through the use of Lighting control in Mohammad Alkhalil villa

Lighting control	Percentage%
Time switched	10%
Presence depending	20%
Presence and brightness depending	40%
Constant brightness control	50%
Blind control	4-9%

8. Recommendations :

- this paper calls for new and comprehensive visions of the scientific and technological foundations of a society of the future, one which is sustainable, attractive, and fulfills human needs and aspirations.
- we should not allow new technologies that consume exorbitant amounts of energy to flourish.
- We must evaluate each new technology not only by its importance in advancing our society or because it makes life easier and more convenient, but by the long-term effects of it.
- to demonstrate interactive arch. to be durable in the future, the Architects should realize that one can do more with intelligent architecture than control heating, airflow that virtual projects will be transformed from their conceptual existence to become practical applications..

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